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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/717,122	11/19/2003	Larry Zhao	2000.106900	7303

23720 7590 01/03/2007
WILLIAMS, MORGAN & AMERSON
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HOUSTON, TX 77042

EXAMINER

GHYKA, ALEXANDER G

ART UNIT	PAPER NUMBER
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2812

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/03/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/717,122

Applicant(s)

ZHAO ET AL.

Examiner

Alexander G. Ghyka

Art Unit

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 39-56 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 39-56 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

ALEXANDER GHYKA
PRIMARY EXAMINER

Av 2812
Alex Ghyka

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 19 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. ____.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date ____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date ____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: ____.

DETAILED ACTION

Claims 39-56 are under consideration. The following **new** rejection is made in view of Applicants' argument. Accordingly, this Office action is a non-final rejection

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 39-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser et al (WO 03/007368).

The present claims generally require providing a structure comprising an exposed copper surface; and performing a single deposition process to form a single silicon nitride layer on said exposed copper surface, said single silicon nitride layer

having a first surface that interfaces with the exposed copper surface and a second surface that is opposite the first surface, wherein the parameters of the deposition process are adjusted such that a concentration of silicon in said single silicon nitride layer gradually increases from the first surface to the second surface.

Besser et al disclose that the electromigration resistance of nitride capped Cu is improved by controlling the silicon nitride deposition. See the Abstract. Besser et al disclose introducing a wafer containing copper into a chamber; treating the exposed surface of Cu with a plasma containing ammonia or nitrogen; introducing silane until a flow rate of about 70 to about 90 sccm is achieved, typically in about 2 to 5 seconds, followed by a stage during which the silane flow rate is increased to about 130 to about 170 sccm over a period of about 3 seconds to about 8 seconds, to form a silicon nitride layer by plasma enhanced chemical vapor deposition. See page 4, lines 20-30. Besser et al does not disclose interruption of the plasma, as required by present Claims 40, 45 and 48-53. Moreover, Besser et al discloses two separate sets of deposition parameters and a single silicon nitride layer, as required by present Claims 41, 42, 43 and 54-56. See page 4, lines 20-30.

Besser et al differs from the present claims in that it does not disclose that the concentration of silicon in the silicon nitride layer gradually increases from the first surface to the second surface, and the specific flow rates as required by some of the dependent Claims.

It would have been obvious for one of ordinary skill in the art, at the time of the invention, that as the silicon precursor silane is gradually increased as disclosed by

Besser et al, the concentration of the silicon would gradually increase. One of ordinary skill in the art would find it obvious that the increase of the silicon containing reactant, silane, would result in increased amounts of silicon in the silicon nitride layer formed by Besser et al.

Claims 47 and 53 further require a deposition process for forming a nitride layer comprising a silane flow rate of approximately 120-170 sccm and a nitrogen flow rate of approximately 220-330 sccm; and transitioning to a deposition process comprising a silane flow rate of approximately 200-250 sccm and a nitrogen flow rate of approximately 30-80 sccm.

It would have been obvious to one of ordinary skill in the art, at the time of the invention, to arrive at the flow rates as required by the present claims, as Besser et al disclose the same process, silicon nitride formation, using the same reactants, silane and nitrogen, and the use of optimum flowrates for the known reactants would be within the level of one of ordinary skill in the art. Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation. See *Allen et al v. Coe*, 57 USPQ 136. Moreover, the discovery of an optimum variable in a known process is ordinarily within the skill in the art. See *In re Antonie*, 195 USPQ 6, (CCPA 1977); *In re Aller* 105 USPQ 233 (1955). In the present case the determination of the optimum flowrates for the reactants would be a matter of optimization for one of ordinary skill in the art, and therefore a *prima facie* case of obviousness is established

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander G. Ghyka whose telephone number is (571) 272-1669. The examiner can normally be reached on Monday through Friday during general business hours.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AGG
December 19, 2006

ALEXANDER GHYKA
PRIMARY EXAMINER

AV 2812
